Microstructural effects and kinetics of high temperature oxidation in Nb-Si base alloys

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Multiphase Niobium-Silicon alloys offer great potential as a new generation of refractory material system that could meet the high-temperature capability envisaged to exceed the application temperatures of Ni base superalloys. One of the serious concerns in the application of Nb based alloys is their poor oxidation resistance at elevated temperatures. However, alloying of the Nb solid solution phase can be quite effective in obtaining remarkably improved high-temperature oxidation resistance without compromising other high-temperature mechanical properties. Several researchers have investigated microstructures and properties of Nb-Ti alloys containing Si as one of the main the main alloying addition, together with other elements such as Cr, Al, Mo and Hf. Alloy systems containing high volume fractions of high-melting intermetallic silicide phase together with the ductile refractory solid-solution phase have been studied in detail in the past. In this paper an overview of the high temperature oxidation resistance of these multiphase alloys will be provided. Calculated phase diagrams will be examined with a view to exploring a variety of possible invariant reactions in these systems and the effect of alloying elements on the stability and distribution of silicides, mainly Nb_3Si and Nb_5Si_3 will be illustrated. The effect of microstructural distribution on high temperature oxidation resistance of multiphase alloys will be discussed. In addition, the overall kinetics of the oxidation reaction, the nature of the reaction products and the development of the oxidation products as well as the mechanism of oxidation will be discussed.